

ART. IV.—*Notes on the Lilydale Limestone.*

(With Plates VIII and IX.)

By REV. A. W. CRESSWELL, M.A.

[Read July 14, 1892.]

The limestone formation of Cave Hill quarry at Lilydale, the subject of this paper, is, for the most part, a hard semi-crystalline marble deposit, wedged in between hard quartzite on the one side, and soft shales and mudstones on the other; and has for many years past been recognised by Professor Sir F. M'Coy and others as of Upper Silurian age, of about the horizon of the English Wenlock, from an inspection of its contained fossils. The limestone strata dip to the east at varying angles of from 35° to 50° , the strike being nearly north and south magnetic, varying, however, on the east side of the quarry to as much as 18° east of magnetic north. The exact thickness of the limestone is not as yet known, for it does not naturally crop out on the surface, but is only artificially exposed by quarrying. As early as 1856, the late director of our Victorian Geological Survey, Mr., now Sir A. R. C. Selwyn, speaks* of the limestone as known to exist, but as only discoverable by a well-like hole on the side of the hill, leading into a cave hollowed out in the rock, and sloping down to a depth of 120 feet, with stalactites, &c. (a specimen of which is shown). But about fifteen years ago, a quarry was excavated in the limestone on the side of the hill, and the opening to the cave is now covered up with *débris*, and is inaccessible.

The progress of quarrying has now proved the limestone to be of much greater thickness than was at first reported.† The measurement across the outcrop is about 5 chains, or

* Report on Geological Structure of Colony of Victoria: Basin of Yarra, &c., 1856.

† "Victorian Naturalist," 1885, II, No. 3, p. 35.

330 feet, and allowing for the average dip of 40° , this would mean a vertical thickness of about 220 feet, but this is only so far as it is at present exposed. Its eastern limit may be considered to be about already reached, for almost immediately flanking it on that side may be seen an extensive series of quartzite and conglomerate strata, running conformably with the limestone; but on the west it is not yet defined as it

CORRIGENDA ET ADDENDA.

Page 39. —For (See Fig. 1), read (See Fig. 9, Plate IXA).

For (See Fig. 2), read (See Fig. 10, Plate IXA).

„ 41.—Read “*Pleurorhynchus costatus*” and “*Pleurorhynchus bellulus*” under *Lamellibranchiata*, instead of under *Gasteropoda*.

Plate VIII.—1. *Tremanotus pritchardi*.

2. *Eunema etheridgei*.

3. *Stomatia antiqua*.

„ IX.—4. *Tryblidium nycteis*.

5. *Pleurorhynchus costatus*.

6. *Pleurorhynchus bellulus*.

7. *Naticopsis lilydalensis*.

8. *Ambonychia tatei*.

appears in the quarry, when looked at as a whole, and from a distance, is cream, or almost white, especially on weathered exposures; but when freshly broken, it is of different shades of dark or light bluish grey, pinkish brown, or grey with pinkish brown patches. It is for the most part semi-crystalline, is here and there somewhat brecciated on a small scale, and is in some places roughly oolitic (a slide of an oolitic specimen on view).

ART. IV.—Notes on the Lilydale Limestone.

PLATE VIII

débris, and is inaccessible.

The progress of quarrying has now proved the limestone to be of much greater thickness than was at first reported.† The measurement across the outcrop is about 5 chains, or

* Report on Geological Structure of Colony of Victoria: Basin of Yarra, &c., 1856.

† "Victorian Naturalist," 1885, II, No. 3, p. 35.

330 feet, and allowing for the average dip of 40° , this would mean a vertical thickness of about 220 feet, but this is only so far as it is at present exposed. Its eastern limit may be considered to be about already reached, for almost immediately flanking it on that side may be seen an extensive series of quartzite and conglomerate strata, running conformably with the limestone; but on the west it is not yet defined, as it is still partly covered over with basaltic soil and decomposing basalt. (See Fig. 1.)

About half a mile off, or rather less, to the west, and on the other side of the valley, are a series of sandstones, shales, and mudstones exposed beneath the basalt in the Melbourne Road cutting, and seen to be dipping in the same direction as the limestone.

The lateral extension of this Lilydale limestone is a matter of much uncertainty. It is generally believed to be like most other Silurian limestones, and especially in Victoria, a mere lenticular or cake-like patch that rapidly thins out in all directions, but as the country in the neighbourhood is completely covered over with soil, trees, and verdure, it must remain more or less a matter of conjecture, until someone is enterprising enough to prospect the country, if not with a diamond drill, at least with a geological cheese-borer. Its *northern* extension has not been observed at all, but what looks somewhat like a *southern* extension of it may be seen in the shape of two bosses of the same kind of limestone in the side of the railway cutting, about three-quarters of a mile towards Melbourne, and somewhere about on the line of the strike of the limestone at Cave Hill quarry.

As it is hardly conceivable that the great thickness of the Cave Hill limestone, however lenticular it may be, can thin out so rapidly as all this, these two bosses, or boulders, in the railway cutting are probably mere outlying boulders of a southerly extension of the limestone that is mainly concealed beneath the surface. (See Fig. 2.)

The general colour of the Cave Hill limestone, as it appears in the quarry, when looked at as a whole, and from a distance, is cream, or almost white, especially on weathered exposures; but when freshly broken, it is of different shades of dark or light bluish grey, pinkish brown, or grey with pinkish brown patches. It is for the most part semi-crystalline, is here and there somewhat brecciated on a small scale, and is in some places roughly oolitic (a slide of an oolitic specimen on view).

The limestone strata are separated at intervals by five dark shaly or mudstone partings, averaging from 18 inches to 4 feet across; the thickest one, which is of a dark brown or claret colour, is upwards of 4 feet, and in this one is an almost perpendicular shaft-like cave, 91 feet deep, apparently caused by the action of running water.

I am informed by the owner, Mr. David Mitchell, of Burnley, that the limestone of his quarry has been long ago analysed, and runs to 95 or 96 per cent. of calcium carbonate. The limestone is in high esteem as the best and purest source of lime for building purposes in the colony. It has also been lately turned to profitable account in the manufacture of cement, and the owner informs me that the force required to pull it apart is 985 lbs. The stone has not been directly used for building purposes, but some slabs, which, when polished up, have an ornamental appearance, have been occasionally used for marble mantelpieces. Upon the whole, I think, therefore, we may congratulate Mr. David Mitchell upon having a more payable thing in his possession than many a gold mine. When the quarry has been in full work in prosperous times, he tells me that he has had as many as 120 men employed on it, and has been able to send away the almost incredible amount of 70 tons of lime a day. In these days of depression, however, when there is so little demand for lime, 20 men are found quite sufficient to do all the work of the quarry that is required.

The limestone of Cave Hill, like most other limestones, contains occasional patches of crystalline calcite, mostly in rhombohedrons or in modified scalenohedrons. It also contains segregated lumps and layers of chert, in which corals and other small fossils are sometimes beautifully preserved (specimens of both calcite and chert are exhibited). Associated with this same limestone, the following minerals have been found, but not in sufficient quantity to be of any commercial importance:—Galena, malachite, azurite, and copper and iron pyrites (specimens on the table). The great interest, however, of the Lilydale limestone lies in its fossils—of which, indeed, the limestone itself is largely composed—and which constantly attract scientific visitors from Melbourne and other places, and indeed from the neighbouring colonies.

In fact, one of my chief reasons in writing this paper is to take possession, in the name of Victorian geologists, of the priority in describing some of the fossils, as at present so many of them have been described by geologists outside the

colony; for without a moment wishing to do away with that principle of free-trade in scientific research that we all so much rejoice in, or desiring to make any undue claim for protection to native industry in Victorian geology, I think you will agree with me that it is but right that we should try to take inventories of our own possessions for ourselves, and not leave it to outsiders to do it for us.

The following is a list of the Lilydale fossils that have been so well described by Mr. Robert Etheridge, jun., Government Palæontologist of New South Wales, in Nos. 3 and 7, Vol. I, of the "Records of the Australian Museum," there:—*Favosites grandipora*, *Trochus* (*Scalætrochus*) *lindströmi*, *Niso* (*Vetotuba*) *brazieri*, *Cyclonema australis*, *Cyclonema lilydalensis*, *Phanerotrema australis*, *Oriostoma northi*, *Murchisonia attenuata* (?), *Bellerophon cresswelli*, *Ambonychia poststriata*. In addition to these, Mr. Etheridge records, without describing, the well-known and world-wide Silurian brachiopod, "*Atrypa reticularis*," and mentions also that there are three species of the well-known Rhizopod "*Stromatopora*" yet to be described. The fossils which I myself wish to record, as also occurring in the Lilydale limestone, and as a supplementary list to that supplied by Mr. R. Etheridge, jun., are the following:—

MOLLUSCA AND MOLLUSCOIDEA.

Cephalopoda.—*Orthoceratites*, sp.; and *Discoceras?* sp.

Bellerophontidae.—*Tremanotus pritchardi*.

Gasteropoda.—*Eunema etheridgei*, *Stomatia antiqua*, *Tryblidium* (*Metoptoma*) *nycteis*, *Pleurorhynchus* (*Conocardium*) *costatus*, and *Pleurorhynchus* (*Conocardium*) *bellulus*, *Naticopsis lilydalensis*.

Lamellibranchiata.—*Ambonychia tatei*.

Brachiopoda.—*Strophomena rugosa*, *Leptœna transversalis*, *Orthis elegantula*.

CŒLEENTERATA.

Actinozoa.—*Heliolites*, sp.; *Cyathophyllum*, sp.

Some of these names will at once be recognised as being those of world-wide Upper Silurian forms, but the following species are new, as far as my knowledge goes, and so I

will venture to name and describe them as such, at least provisionally :—

The first and most important to be described is a shell belonging to the Bellerophontidæ, a group of extinct shells of generalised form, which had characters that are now divided between the Cephalopoda, the Heteropoda, and groups of Gasteropoda, of which Pleurotomaria and Haliotis are respectively the types. It is a *Tremanotus* which I have named *T. pritchardi*, in compliment to Mr. G. B. Pritchard, a well-known geological friend, who has kindly lent me the best specimen that I have with me, and which he found in the Lilydale quarry some time ago. *Sp. Char. of T. pritchardi* shell discoidal, bi-concave, trumpet-shaped, and very thick, consisting of about five rapidly increasing whorls, forming a deep umbilicus on both sides; spire elliptical in section, and back symmetrically convex. Breadth of the shell about two inches, length from three and a half to four inches. Aperture very much expanded and reflected like the mouth of a trumpet, but more so anteriorly than laterally; the inner surface of expanded outer lip quite smooth. No slit or sinus as in Bellerophon, but the middle dorsal line of the shell is pierced by a row of oval siphonal openings, resembling those of Haliotis, there are about seven of them to an inch of the periphery. The outer surface of the shell is ornamented with spiral fluctuating lines parallel to the dorsal keel, and becoming on the expanded outer lip more flattened, coarser, and more plait-like. There are also the very distinct lines of growth in a transverse and backward direction to the dorsal keel, that are so characteristic of the Bellerophontidæ. The lines in the two directions combining in this shell to give a very distinct fenestrated appearance. *T. pritchardi* has in general form a near resemblance to "*Tremanotus maideni*," described by Mr. Robert Etheridge,* from the Hawkesbury (Trias) rocks of New South Wales, and which he regards as a curious survival from Silurian times, but, besides other differences, our fossil is a very much thicker shell.

The next fossil to be briefly described as far as may be from very imperfect specimens, is *Eunema etheridgei*, a gasteropod shell that appears to belong to the Littorinidæ,

* Department of Mines.—Memoirs of Geological Survey of New South Wales. Palæontology I. Invertebrate Fauna of Hawke-bury; Wianamatta Series, by Robert Etheridge, jun.